

AD-A188 468

EVALUATION OF CHEMICAL AND ATMOSPHERIC SCIENCES  
RESEARCH(U) GEORGETOWN UNIV WASHINGTON DC DEPT OF  
CHEMISTRY J E EARLEY 14 SEP 87 AFOSR-TR-87-1705

1/1

UNCLASSIFIED

F49620-84-C-0073

F/G 7/1

NL





ROCOPY RESOLUTION TEST CHART

AD-A188 468

REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 0704-0188

REPORT SECURITY CLASSIFICATION  
Unclassified

SECURITY CLASSIFICATION AUTHORITY

DECLASSIFICATION/DOWNGRADING SCHEDULE

01 1987

PERFORMING ORGANIZATION REPORT NUMBER(S)

88 D

1b. RESTRICTIVE MARKINGS

3. DISTRIBUTION/AVAILABILITY OF REPORT  
Approved for public release;  
Distribution unlimited

5. MONITORING ORGANIZATION REPORT NUMBER(S)  
AFOSR-TN-87-1703

NAME OF PERFORMING ORGANIZATION  
Georgetown University

6b. OFFICE SYMBOL  
(if applicable)

7a. NAME OF MONITORING ORGANIZATION  
AFOSR/NC

ADDRESS (City, State, and ZIP Code)

Department of Chemistry  
Washington, DC 20057-0001

7b. ADDRESS (City, State, and ZIP Code)

Bldg 410  
Bolling AFB DC 20332-6448

8a. NAME OF FUNDING/SPONSORING ORGANIZATION  
AFOSR

8b. OFFICE SYMBOL  
(if applicable)  
NC

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER  
F49620-84-C-0073

8c. ADDRESS (City, State, and ZIP Code)

Bldg 410  
Bolling AFB DC 20332-6448

10. SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.
61102F	2303	A1	

11. TITLE (Include Security Classification)

Evaluation of Chemical and Atmospheric Sciences Research

12. PERSONAL AUTHOR(S)

Dr Joseph E Earley

13a. TYPE OF REPORT  
Final

13b. TIME COVERED  
FROM 15 Sep 84 to 14 Sep 87

14. DATE OF REPORT (Year, Month, Day)  
14 September 1987

15. PAGE COUNT  
15

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

During the period covered by this report, six plenary meetings of the Chemistry Research-evaluation Panel for the Air Force Office of Scientific Research have been held: at Santa Fe, New Mexico on November 8 and 9, 1984; at Baltimore, Maryland on May 9 and 10, 1985; at Galveston, Texas on November 14 and 15, 1985; at Alexandria, Virginia on May 15 and 16, 1986; at the US Air Force Academy, Colorado on November 13 and 14, 1986; and at Georgetown University on May 14 and 15, 1987. During the period of this report, a total of two hundred and ninety-four proposals in the chemical and atmospheric sciences were evaluated and ranked. Panels of evaluators were provided for contractors' meetings that dealt with specific portions of the on-going Air Force Office of Scientific Research chemistry research program. These meetings were held in Albuquerque, New Mexico in October, 1984; in Dayton, Ohio in November, 1985 and in Bedford, Massachusetts in October, 1986. Reports covering each of these meetings have been submitted.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT

☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS

21. ABSTRACT SECURITY CLASSIFICATION  
UNCLASSIFIED

22a. NAME OF RESPONSIBLE INDIVIDUAL  
Dr Anthony J Matuszko

22b. TELEPHONE (Include Area Code)  
(202) 767-4963

22c. OFFICE SYMBOL  
NC

Georgetown University  
Department of Chemistry

NOV 3 1987

Final Technical Report  
Contract F49620-84-C-0073

U.S. Air Force Office of Scientific Research  
For the period September 10, 1984 to September 14, 1987

An earlier comprehensive interim technical report was submitted to cover the period from September 10, 1984 to June 5, 1986.

During the period covered by this report, six plenary meetings of the Chemistry Research-evaluation Panel for the Air Force Office of Scientific Research have been held. The sixty-ninth chemistry research evaluation meeting for Air Force Office of Scientific Research was held at Santa Fe, New Mexico on November 8 and 9, 1984; forty proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report specifying that rank-order (including atmospheric-science proposals) has been submitted and is appended as Appendix I. The seventieth chemistry research-evaluation meeting for the Air Force Office of Scientific Research was held at Baltimore, Maryland on May 9 and 10, 1985; sixty-one proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report specifying that rank-order (including atmospheric-science proposals) has been submitted and is appended as Appendix II. The seventy-first chemistry research-evaluation meeting for the Air Force Office of Scientific Research was held at Galveston, Texas on November 14 and 15, 1985; sixty-three proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report specifying that rank-order (including atmospheric-science proposals) has been submitted and is appended as Appendix III. The seventy-second chemistry research-evaluation meeting for the Air Force Office of

Approved for public release.  
distribution unlimited

Scientific Research was held at Alexandria, Virginia on May 15 and 16, 1986; fifty-eight proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report specifying that rank-order (including atmospheric-science proposals) has been submitted and is appended as Appendix IV. The seventy-third research-evaluation meeting was held at The U.S. Air Force Academy, Colorado on November 13 and 14, 1986; thirty-three proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report specifying that rank-order (including atmospheric-science proposals) has been submitted and is appended as Appendix V. The seventy-fourth chemistry research-evaluation meeting was held at Georgetown University on May 14 and 15, 1987; thirty-nine proposals were considered at that meeting, and relative rankings for scientific quality were determined. An interim technical report has been submitted and is appended as Appendix VI. During the period of this report, a total of two hundred and ninety-four proposals in the chemical and atmospheric sciences were evaluated and ranked.

Panels of evaluators were provided for contractors' meetings that dealt with specific portions of the on-going Air Force Office of Scientific Research chemistry research program. These meetings were held in Albuquerque, New Mexico in October, 1984; in Dayton, Ohio in November, 1985 and in Bedford, Massachusetts in October, 1986. Reports covering each of these meetings have been submitted.



DET	APPROVED FOR
A-1	

Persons who have served as members of Chemistry and atmospheric-science evaluation panels during this period include:

Professor Claude F. Bernasconi  
Department of Chemistry  
The University of California  
Santa Cruz, California 95064

Dr. Enrico Clementi  
IBM Fellow  
IBM Corporation,  
Kingston, New York 12401

Professor Joyce Y. Corey  
Department of Chemistry  
The University of Utah  
Salt Lake City, Utah 84112

Dr. Joseph E. Demuth  
Thomas J. Watson Research Center  
IBM Corporation  
Yorktown Heights, New York 10598

Dr. Jimmie D. Doll  
Department of Chemistry  
Los Alamos National Laboratory  
Los Alamos, New Mexico 87545

Professor Dennis H. Evans  
Department of Chemistry  
The University of Wisconsin  
Madison, Wisconsin 53706

Dr. George S. Hammond  
Director  
Integrated Chemical Systems  
Laboratory  
Allied-Signal Corporation  
Morristown, New Jersey 07960

Professor William B. Hanson  
Director  
Center for Space Sciences  
The University of Texas, Dallas  
Richardson, Texas 75080

Professor H. James Harwood  
Chairman  
Institute of Polymer Science  
University of Akron  
Akron, Ohio 44325

Professor James Holton  
Department of Atmospheric Science  
The University of Washington  
Seattle, Washington 98195

J. J. Lagowski  
Piper Professor of Chemistry  
The University of Texas  
Austin, Texas 78712

Professor Donald Levy  
Chairman, Department of Chemistry  
The University of Chicago  
Chicago, Illinois 60637

Professor Robert J. Madix  
Department of Chemical Engineering  
Stanford University  
Stanford, California 93405

Professor C. Bradley Moore  
Chairman, Department of Chemistry  
The University of California  
Berkeley, California 94720

Professor Royce W. Murray  
Department of Chemistry  
The University of North Carolina  
Chapel Hill, North Carolina 27514

Professor Robert Silbey  
Department of Chemistry  
Massachusetts Institute of Technology  
Cambridge, Massachusetts 02139

Professor William C. Stwalley  
Department of Chemistry  
The University of Iowa  
Iowa City, Iowa 52242

Professor Richard P. Van Duyne  
Department of Chemistry  
Northwestern University  
Evanston, Illinois 60201

Dr. Field H. Winslow  
Bell Laboratories  
600 Mountain Avenue  
Murray Hill, New Jersey 07974

Teams of evaluators were provided on several occasions to evaluate portions of the research program of the Air Force Office of Scientific Research. Teams evaluated contractors' meetings in the field of chemical dynamics held in the Fall of each of the three years covered by the contract; in October, 1984 in Albuquerque, New Mexico, in November, 1985 in Dayton, Ohio and in November, 1986 in Concord, Massachusetts. Interim technical reports have been submitted to cover these activities.

A special research-evaluation panel was constituted for the purpose of advising the Director of Chemical Sciences, Air Force Office of Scientific Research, and other appropriate Air Force officers and civilian scientific officers concerning a program in high-energy-density materials being conducted by the Air Force Rocket Propulsion Laboratory. Two meetings were organized at which contractors and prospective contractors presented discussions of their scientific work, one in Washington, DC, March 20-21, 1986 and one in Rosslyn, Va. on May 12 and 13, 1987. In connection with each of these contractor's meetings, and also in Lancaster, California on May 17 and 28, 1986 and at The U.S. Air Force Academy, Colorado on November 12 and 13, 1986 meetings of the high-energy-density-materials research-evaluation panel were held to consider proposals and to provide other evaluation of the high-energy-density program. A total of fifty-seven proposals was considered at these three meetings, and relative rankings for scientific quality were determined. Reports were submitted to cover these activities. An evaluation team was constituted to evaluate certain research being carried out at the California Institute of Technology. A report of findings of that evaluation was submitted. (Appendix VII)

Persons who have been members of the high-energy-density materials panel are:

Professor Charles F. Bender  
Advanced Computational Methods Center  
The University of Georgia  
Athens, Georgia 30602

Professor William Happer  
Department of Physics  
Princeton University  
Princeton, New Jersey 08544

Professor M. Frederick Hawthorne  
Department of Chemistry  
The University of California  
Los Angeles, California 90024

Dr. Ronald R. Herm  
The Aerospace Corporation  
Los Angeles, California 90009

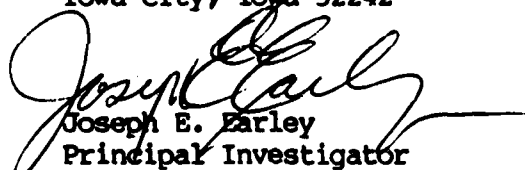
Dr. Marilyn E. Jacox  
Molecular Spectroscopy Division  
The National Bureau of Standards  
Gaithersburg, Maryland 20899

Lewis H. Nosanow  
Vice Chancellor for Research  
The University of California  
Irvine, California 92717

Professor Isaac F. Silvera  
Lyman Laboratory of Physics  
Harvard University  
Cambridge, Massachusetts 02138

Professor William C. Stwalley  
Iowa Laser Facility  
The University of Iowa  
Iowa City, Iowa 52242

Submitted by,

  
Joseph E. Farley  
Principal Investigator  
October 26, 1987



Georgetown University  
Department of Chemistry

## Revised Technical Report for AFOSR Chemistry Research-Evaluation

Category I		Category II	
A	82 West	97 Crosley	96 Bernasek
A-	80 Ault	64 Cowin	
	79 Dovichi	70 Metiu	
	78 DeLevie*	71 Redner	
		74 Heaven	
		65 Cool	
		60 Miller	
A-/B+		69 Thompson	
		67 Gardner	
B+	66 Weber	68 Wolf	
	81 Horn	63 Liu/Ziv/Tsong	
	86 Calcote	62 Rosenfeld	
	93 Dresselhaus	73 Kaufman	
	58 Bumgardner	95 Becker/Gillen	
	89 Soong	75 Andermann	
	76 Tilley		
	85 White		
B/B+	91 Blumstein		
B	84 Hosmane		
	94 Niemczyk		
	90 Chien		
	92 Tomozawa		
	87 Akinc		
	77 Shellhamer		
Ranking deferred:			
	78 DeLevie	98 Mukamel**	
	88 White/Kyu**		

\* not ranked in conjunction with other A's

\*\* additional review required

Joseph E. Barley  
Professor and Chairman  
Principal Investigator  
December 5, 1984

## Georgetown University

## Department of Chemistry

Contract F49670-84-C-0073

## Interim Technical Report for AFOSR Chemistry Research-Evaluation

Category I			Category II		
A+			A+	15	Zare
				58	Wittig
A	50	Collman	A	30	Leone
	23	Tyler		07	Steinfeld
				32	Houston
				03	Pratt
				60	Benziger
				20	Crim
				47	Rossi
				37	Campion
				04	Kinsey
A-	11	Clearfield	A-	27	Bowers
	39	Dewar		02	Parmenter
	26	Nocera		24	George
	51	Reiss		56	Cooper
	46	Green		25	Dyke
	22	Clearfield		01	Sullivan
				41	Pimental
				55	Rothe / Reck
B+	42	Mamantov	B+	14	Raff
	57	Hughes		54	Topp*
	43	Trogler		53	Sloan
	40	Ewig / Van Wazer		12	Murray
	10	Koenig		31	Schwerzel*
	09	Weeks		28	Kupperman
	45	Klein			
	44	Smith			
B	08	Czarnik	B	52	Van Hove*
	34	Stimming		29	Lauer
	05	Cotts			
	06	Potember			
C	61	Bockris	C	13	Daily
	19	Toy			
	21	Levy			

\*additional review suggested

Joseph E. Earley  
Professor and Chairman  
Principal Investigator  
May 15, 1985

Georgetown University  
Department of Chemistry

Interim Technical Report for AFOSR Chemistry Research-Evaluation

	Category I	Category II	Category III
A	103 Stone 104 McCreery	83 Yates 76 Yarkony 77 Goddard	62 Tsunoda 73 Wickwar 71 McClure
A-	109 Ratner 90 Geoffroy 91 Davis 111 Anson 117 Gillis(*) 94 Lemal	92 Hemminger 89 Leventhal 75 McKoy 78 Engel 114 Martin 88 Erskine 101 Nesbitt 124 Weissnar 120 Futrell 116 Bernstein 85 Golde 86 Slinger 70 Weltner 97 Adams	64 Markson 69 Imhof 63 Dunkerton
B+	102 Brajter-Toth 108 Weaver 93 Bennett 115 Bunding 72 Welch 80 Caruso 106 Isayev*	107 Tolk 121 Morse 100 Trenary 123 Vasudev 82 Ogilby 67 Davis (rtn) 89 Davis (therm) 125 Glyde* 99 Jones & Weatherford* 87 Hopster* 113 Redner*	79 Bryson
B	98 Tien	96 Hudson 112 Andermann 118 Helvajian 119 Stedman 122 Denison 65 Ohrn and Zerner	59 Lucas
C	95 Kordas 105 Brostow 110 Neelakantaswamy	81 McQuistan	66 Ganguly

Joseph E. Earley  
Professor and Chairman  
Principal Investigator  
November 18, 1985

\*tentative ranking, pending further review

Georgetown University  
Department of Chemistry

Interim Technical Report for AFOSR Chemistry Research-Evaluation  
Contract F49620-84-C-0073

	Category I	Category II	Category III
A+		14 Zewail 18 Cavanagh	
A	51 Turro*	20 Heller 25 Helm 13 Ross 51 Turro* 26 King 52 Schaefer	73 Wickwar 74 Schotland 128 Fritts
A-	49 Eisenthal* 50 Weaver 43 McKinstry 34 Martin 39 Sneddon 35 Goldberg*	49 Eisenthal* 05 Williams 08 Truhlar 30 Weitz 44 Dyke 48 Marks 32 Madix*	69 Imhof 127 Rahn 129 Adams 27 Keyser 29 Liou
B+	21 Tomkiewicz 40 Shreeve 41 Wolczanski 02 Tidwell 47 Berry 37 Mauritz 22 King 04 Ojima 06 Nicholas 32 Madix*	16 Schwartz 24 Schulz 15 Balasubramanian 23 Brumer 11 Streitwieser 36 Redmon 17 Stair 09 Gordon 42 Sloan 19 Adelman 45 Worsnop 35 Goldberg* 53 Somorjari 33 Graff	28 Warner
B	01 Jones	46 Kupperman 12 Rice 10 Wulfman 38 Hamilton 03 Wachman 07 Avnir	
C	31 Deymier		130 Armstrong

Joseph E. Earley  
Professor and Chairman  
Principal Investigator  
May 20, 1986

\*in both I and II

Georgetown University  
Department of Chemistry

Interim Technical Report for AFOSR Chemistry Research-Evaluation  
Contract F49620-84-C-0073

	Category I	Category II	Category III	Category IV
A+				344 Moore 345 Lester
A	70 Ratner 82 Schrock	86 Neumark 80 Prasad*	60 Hernandez	314 Cassasa 320 Engelking 342 Bae 305 Carpenter
A-	65 Doherty 71 Ellis 80 Prasad*	55 Mukamel 73 Williams 56 Fano 77 Kolb 81 Guberman		302 Bernath 341 Daley 338 Schaeffer 340 Scobilgen 325 Weitz 319 Apkarian
B+	64 Holmes 83 Hosmane 74 Damrauer 72 Lagow 59 Norman 78 Wolfe	79 Rabitz# 54 Bauer 75 Leventhal 66 Page 88 Coombe 84 Fenn	68 Balachandran	311 Gilbert 315 Brener 333 Dagligian 335 Kirby 336 Hardwick 306 Politzer 334 Miller
B	58 White	76 Abeles 61 Peterson	69 D'Angelo	343 Nicolaides 303 Eisenthal 331 Yarkony 309 Wight 301 Shearer 313 Allen 304 Nichol
			67 Pielke	
C	63 Abrahamson	57 Khait 62 Brown		307 Davis 308 Ortiz 316 Garrett 323 McFarlane 346 Bass 347 Kumar
R				312 Haloulak

*Joseph E. Earley*  
Joseph E. Earley  
Professor and Chairman  
Principal Investigator

\*in both category I and category II  
#additional reviews pending

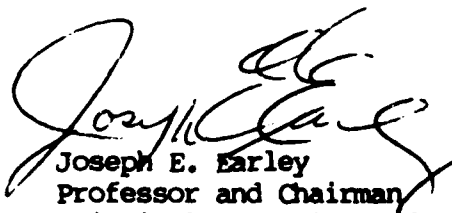
November 14, 1986

Georgetown University  
Department of Chemistry

Appendix VI

Interim Technical Report for AFOSR Chemistry Research-Evaluation

	Category I	Category II	Category III	Category IV
A	13 McCreery	33 Field 10 Leone 04 Smith 27 Hepburn	35 Cotton*	203 Grant 209 Kinhead (O <sub>2</sub> -F <sub>2</sub> part)
A-	23 Verkade 09 Heinekan/Elder	28 Trenary 12 Winograd 26 Cooper 11 Eyler 17 Bernath 03 Marx 20 Kellmann		201 Politzer 206 Berkson
B+	31 Kuivila 19 King 29 Boudjouk 37 Fratini 08 Goodenough	16 Gole 15 Bauer 39 Oldenburg	06 Adams 36 Lee* 38 Uthe*	207 Dagdigian 204 Steadman 212 Hehre 202 Kirby
B	01 Huppert 14 Lee 34 Donahue 25 Welsh	07 Czanderna 24 Whitehead 21 Felder 22 Turner		205 Hardwick 213 Eisenthal 214 Harbottle* 208 Ortiz 209 Kinhead (Matrix part) 210 Allen
C	18 Mark	30 Bates# 32 Lowdin		211 Vernecker

  
Joseph E. Earley  
Professor and Chairman  
Principal Investigator

May 15, 1987

\*tentative rating, pending further review.

#proposal insufficient and incomplete

DEPARTMENT OF THE AIR FORCE  
AIR FORCE ASTRONAUTICS LABORATORY (AFSC)  
EDWARDS AIR FORCE BASE, CALIFORNIA 93523-5000

RTAO: CX (Lt Lauderdale, 5413)

16 JUL 1987

SUBJ: Trip Report for Visit to the California Institute of Technology (Cal Tech) on 14 Jul 87

TO: CX  
CC/CV/CA  
IN TURN

1. Abstract. On 14 Jul 87, Lt Walter Lauderdale visited Prof Aron Kuppermann at the California Institute of Technology. Accompanying him on this visit were Dr William Stwalley and Dr Ron Herm, chairman and member of the High Energy Density Matter (HEDM) technical evaluation panel, respectively. The purpose of this visit was to evaluate the technical progress and future plans of contract F04611-86-K-0076, "Experimental Studies of the Properties of Trihydrogen and Tetrahydrogen". The evaluation was prompted by three factors: 1) the seeming lack of progress in the project, 2) the high cost of the overall contract, and 3) FY88 budget constraints.

2. Background. On the morning of 14 Jul 87, prior to the meeting with Prof Kuppermann, Lt Lauderdale met with Dr Herm and Dr Stwalley to discuss the history of Prof Kuppermann's work for the AFAL. Copies of all progress reports and the technical portion of the original proposals, along with the program plans were sent to them earlier. Prof Kuppermann's first contract to the AFAL was awarded in response to the original tetrahydrogen PRDA. This project set ambitious goals of performing  $H3^+ + HI$  crossed beam experiments to determine the possible existence of  $H4$ . During the course of the project, numerous setbacks occurred due to a large attenuation of the  $H3$  beam intensity when the source was mated to the crossed beam chamber. The final result of the original contract was a redesigned  $H3$  source and increased awareness of unforeseen difficulties, but no conclusive crossed beam experiments were performed (see AFRPL-TR-86-103, attached). The current contract is a continuation of this effort. During the first 11 months of the present effort, problems with  $H3$  beam intensity have continued to plague the research. Improvements have been made incrementally and systematically over this time and have resulted in a methodology to locate and center the  $H3$  beam. This provides the intensity, but it is still 3 orders of magnitude less than in the original  $H3$  beam apparatus. The progress to date of the current contract is summarized in the attached quarterly report. This report was submitted as a precursor to the on-site evaluation. Dr Herm and Dr Stwalley were asked to assist in the evaluation in view of their respective backgrounds in molecular beams and in their role as members of the HEDM technical evaluation panel.

3. Results. Prof Kuppermann reviewed his work and was asked questions by Dr Herm and Dr Stvalley during this time. A summary of this discussion is detailed follows.

a. The H3 beam source is initially aligned optically. However, when the arc discharge is started, the H3 beam does not follow the optical axis. Therefore, the beam never appears at the detector because it never passes through the slit aperture downstream. The beam was found by using a larger slit, but a larger slit leads to poor collimation of the beam and a low intensity in the crossed beam interaction region. The solution has been to use a diaphragm slit which can be opened wide (12 mm) to allow location of the beam. The entire source and support structure is then physically rotated around an axis which passes through the arc discharge port. This then brings the beam into the center of the diaphragm and the diaphragm is then closed down to the operating diameter (2 mm).

b. This final solution has consumed the better part of two years (over both contracts). The reasons for this has been that Prof Kuppermann is developing a technology that is available nowhere else. While H3 has been made and characterized by several groups, no other group has a source of any metastable which is as intense as Kuppermann's (in the original H3 beam configuration). Many different variables have had a drastic affect on beam intensity and alignment. These include, but it not limited to, the pressure of the H3 arc source cooling water, the grade of titanium metal used for the anode and cathode of the arc discharge, and the intensity of the background light emitted from the arc discharge (reflected in the current solutions to avoid the light problem within the detector). The affect of these variables, for the most part, were unforeseeable. Also, since this is a unique arc source, the problems could only be discovered after many runs and an examination of the empirical evidence. These were in addition to the normal operating parameters of the experiment such as slit width, skimmer distance, H2 back pressure, discharge voltage, downstream pressure, and all aperture widths, to name a few.

c. The collimation requirement for the beam is quite stringent. This is because the angular region of interest for the scattering experiments is within several degrees of the peak in the H3 beam intensity. If the beam is not well collimated, then its signal will mask the signal from the scattered products of the crossed beams. Closing the aperture to achieve good collimation, however, is useless if the beam does not pass through the resulting slit. This demonstrates how crucial the alignment is in this experiment. In addition, there are still some questions that should be answered about the H3 beam source itself. All of the issues are to be addressed in the H3 phase of the contract, which is scheduled to start upon completion of the H4 work.

4. Conclusions. Taking into consideration all the results and the discussions with Dr Herm and Dr Stvalley, conclusions are:



a. The H3 beam source still requires characterization and refinement independent of the H4 experiment.

b. In retrospect, the HEDM panel and the APAL made a mistake in having Prof Kuppermann do the H4 work before the H3 work, which is reversed from the proposal. Prof Kuppermann made a mistake in agreeing to the change. Many of the problems he has run into may have been solved in the H3 work. Doing the H4 work first, however, made sense at the initiation of the contract because H4 was a highly visible part of the ARIES program.

c. The current crossed beam chamber is antiquated. Its use forces a long H3 beam path and attenuates the intensity greatly (intensity is proportional to  $1/r^2$ ). Also, other detection methods which are more sensitive are too large to fit within the chamber, also affecting intensity measurements.

d. Given the current laboratory apparatus, Dr Stvalley and Dr Herm felt that Prof Kuppermann's approach to the problems has been acceptable.

e. Dr Herm and Dr Stvalley believe that conclusive crossed beam results will not occur for at least six months. They also feel that the H4 work should be given no more than 12 months more effort.

f. Dr Herm and Dr Stvalley both emphasize that Prof Kuppermann's work is at a level more basic than fundamental research. The technology of the intense metastable H3 beam is important scientifically. By the very nature of its development, it is difficult to predict all the problems to be surmounted.

g. Dr Herm and Dr Stvalley believe that a well characterized H3\* source is a very valuable asset to the ARIES program's search for new, novel energetic species. H3\* is a very energetic reactant which could be combined with other species to yield a new, high energy density molecule.

5. Recommendations. The recommendations for actions regarding this contract are:

a. Give approval for Prof Kuppermann to begin the work on H3.

b. Pass along suggestions from Dr Herm and Dr Stvalley on Prof Kuppermann's experimental procedures.

c. Negotiate a modification to the contract to suspend the H4 work and place an option to continue it after the H3 work has been completed. The decision to continue the H4 work will be based on the H3 work and the H4 work (theoretical and experimental) being done by other HEDM contractors.

d. Negotiate to delete the purchase of an additional quadrupole mass spectrometer for the H3 work (Dr Herm and Dr Stvalley feel the mass spectrometer used in the original H3 work will be sufficient for

the proposed H3 work).

e. Discuss the possibility of stretching out the effort to ease the budgetary pressure in FY88.

f. Adjust the HEDM FY88 budget (Cluster D-7) to reflect continuation of this contract.

WALTER J. LAUDERDALE, 1Lt, USAF  
Project Manager

2 Atch  
1. AFRPL-TR-86-103  
2. Progress Report

END

DATE

FILMD

3-88

DTIC